The Publication Committee reported upon the subject of the publication of Dr. H. C. Wood's Memoir of the Fresh Water Algæ of the United States.

The Report of the Finance Committee, postponed from the last meeting, was read by its Chairman, Mr. Fraley; and the sums recommended by the Committee were, on motion, appropriated for the expenses of the ensuing year. A further recommendation to increase the insurance on the Hall, was on motion adopted; and the meeting was adjourned.

Revival of Fruit Trees *prematurely ceasing to bear fruit, or prematurely decaying*, by Geo. B. Wood, M. D.

(*Communicated to the American Philosophical Society*, January 6, 1871.)

It is well known that most fruit trees, especially the peach and apple trees, in sites where they have been long cultivated, often cease to bear fruit, and even perish, long before their natural period. Thus the peach, which has a normal life of 50 or 60 years, or longer, and grows under favourable circumstances to the size of a considerable tree, generally, in this part of the United States, ceases to bear fruit after two or three years of productiveness, and soon after begins to decay, seldom living beyond 15 or 20 years. The apple tree also, long before it has attained its normal length of life, often ceases to yield fruit, either for a time or permanently, without apparent cause; and trees, planted on the site of an old orchard which has been removed, not unfrequently refuse to bear at all, or at least to a profitable extent.

It is obviously of great importance to discover the cause or causes of such failures, and, if possible, to apply a remedy or preventive. Unless I greatly deceive myself, I have succeeded in showing that the evil generally has its source in a deficiency of the salts of potassa in the soil, and may be corrected by supplying that deficiency.

The alkali potassa, in combination generally with one or another of the vegetable acids, is an essential ingredient in all plants, excepting the sea plants, in which its place is supplied by soda. In living vegetables it is contained dissolved in the juice, and is consequently most abundant in the most succulent parts; and, when the plants are burned, the alkali is left behind in the ashes, of which it constitutes an exceedingly variable proportion, according to the peculiar plant or part of the plant burned. Thus, while the ashes of oak wood contain only about 3 parts in 1000, those of the common poke, the growing wheat stalk, and the potato stems, contain 48 or 50 parts or more. The greater portion by far of the alkali is in the state of carbonate, with a little in the caustic state, and being, in these conditions, very soluble in water, is extracted by lixiviation

with water, and obtained by evaporating the ley. A much smaller portion is in the form of silicate, which is left behind in the ashes after lixiviation, and gives to the soap-boilers' ashes almost all if not quite all their value as a manure. It is, however, only the fresh-burned ashes, not yet submitted to lixiviation, and consequently still containing the potash in its soluble state, that is applicable to the purpose of supplying the alkali to fruit trees in the mode in which I employ it.

When plants are no longer supplied with the requisite amount of potash, they cease to grow, and at length generally perish. In the case of the succulent fruit trees, as the alkali is required in the largest proportion in the fruit, this is the first to suffer; then the leaves gradually fail; and at length the whole tree dies, limb after limb.

How I came to discover this source of premature failure of fruit trees, and to supply the deficiency by means of the soluble potash contained in fresh ashes, I explained, so far as the peach tree is concerned, in a communication made last year to the Society, which was published in the Proceedings.

In that communication I stated that, believing with most others that the peach tree perishes prematurely, in consequence of being attacked near the root by a species of worm, I employed as a remedy against this parasite, after scraping as far as possible the worm out of the root with a knife, fresh ashes in an excavation about the stem of the plant; supposing that, by their caustic power, they might destroy any remains of the insect or its eggs. This method was not original with myself; as I had seen it practiced in my youth very effectually in keeping a peach orchard in bearing for several years.

The peach trees on which I tried the experiment had long ceased to bear fruit, and were in the last stage of decay; in several instances one or more branches being absolutely dead, and the stem being covered with lichens, as is apt to happen with dying trees.

This was done in the Autumn; the earth having been removed around the stem of each tree to the depth of four or five inches, so as to lay bare the upper surface of the main roots, and the excavation filled with fresh ashes. Next Spring a marvellous change was experienced by the trees. They had recovered more than the vigor of their early life, and bore fruit in an abundance which I had rarely, if ever, witnessed.

I could not conceive that such a result should proceed so rapidly, from the destruction of a few worms. Besides, some of the trees had no worms that could be observed; and yet they had been as far gone, and were as much revived as the others.

I was, therefore, driven to the conclusion, that the ashes had not acted by destroying the worm, but by furnishing to the trees a material necessary to their existence, and from the want of which they were perishing. This could only be the soluble potash contained in the ashes, which being dissolved by the rain, was carried in solution along the roots to the minute rootlets where it was needed.

One important inference, which may be here incidentally mentioned, is

that the peach trees were not dying from the worms, but that these attacked them because they were dying from other causes; and it is probably true, as a general rule, that plants in perfect health are in a condition to protect themselves against destructive parasites, probably because the salts of potash in their vessels are repulsive or even destructive to the parasites, which destroy the plant in the absence of this defense. I am not certain even that the curculio may not attack certain fruits, the plum for example, in consequence of deficiency of the alkali in its juice.

At first my experiments were confined to the peach tree; but it may be remembered that I said in my communication to the Society that the principle was applicable as well to other fruit trees, especially the apple, which often refuses to bear, apparently capriciously, but probably from the same deficiency of potash in the soil.

Last year I had the opportunity of testing the correctness of this supposition. I happened to have two apple orchards; one of them old, perhaps 60 years or more, the other comparatively young, having been planted, 15 or 20 years since, upon a piece of ground which had previously been the site of an apple orchard for I presume nearly a century. Both of these orchards might be considered as nearly or quite barren; the old orchard not having borne fruit of any account for 5 or 6 years; and the young one having never borne at all.

In the Autumn of 1869, I tried with these trees the same experiments as in the Autumn before I had tried with the peach trees. The earth was dug from around their stems to the depth of about 5 inches, and the excavation filled, in each case, with about half a bushel of fresh ashes. As regards the old orchard, a part was allowed to remain without treatment, so as to secure the effect of contrast. In the following Spring and Summer (1870), my expectations were fully realized. Early in the season a striking difference was observed between the trees not treated with ashes and those which had been so treated. A dividing line could be observed between the two sections of the orchard; the trees which had been ashed being forward both in leaf and blossom, while the others had made little progress; and the same contrast was presented in the fruit; the trees left to themselves continuing barren, while the ashed trees were loaded with apples. The young orchard, which had never borne fruit of any account, was also made for the first time very productive.

A similar experiment I tried on several fruit trees of different kinds in my garden in town. Though the ashes were applied in Spring instead of of Autumn, the trees in the growing season gave evidence of a similar result. The trees were richly covered with blossoms, which were just becoming exchanged for young fruit, when the famous hail storm which proved so destructive in this city last Summer, put an end to the experiment by stripping the trees of blossom and fruit, and to a great extent even of their leaves.

Among the trees was a very old Newtown pippen tree, probably of not

less than three-quarters of a century, which had for years ceased to bear, or at best only now and then brought forth a small knotty fruit unfit for use. The tree had been dying branch by branch every year, until reduced almost to the original stem, with a few branches above. This tree appeared in the warm season to have renewed its youth. It was richly loaded with flowers and fruit, and gave hopes of an abundant product in the Autumn. It suffered, however, like the others from the storm; very few of the blossoms or young fruit remaining still attached. One of these went on to full size; and the handsome Newtown pippen which I now exhibit to the members as the sole relict of the storm, shows what the product might have been had not the hail interfered.

I consider that the efficiency of potassa in the revival of fruit trees has been satisfactorily demonstrated by the foregoing experiments, at least in relation to the peach and apple trees, and I may add also the pear and quince, several of which were treated in the same way and with similar results.

As to the securing of the plum and other fruits against the curculio, I think it highly probable that this also may be done by ashes, on the principle already stated, but I can adduce no proof of the fact; for, in the only instance in which ashes were applied to a plum, though the tree showed its effects by a copious growth of leaves and flowers, and even of young fruit; yet the destruction of these by the hail storm prevented the completion of the experiment; and for the determination of this point, which is an important one, we shall have to wait another year.

But, important as I consider the discovery of the reviving power of potassa in the case of failing fruit trees, I attach much greater value to its influence in another direction, which has suggested itself in the prosecution of the foregoing experiments. It is an unfortunate fact, with which the farmers of my own country neighbourhood are unhappily but too familiar, that certain cereal crops, especially that of wheat, have for some years failed to be remunerative. Where wheat formerly yielded 20 bushels or more to the acre, it can now seldom be made to produce more than 12 or 15 bushels.

In examining into the relative proportion of potassa contained in the ashes of different plants, I was surprised to find that, while the ashes of the common fire wood, as the oak, maple, &c., contain from about 2 to 4 parts in 1000, the wheat stalk yields 47 parts. Now, while this fact shows the extraordinary demand of growing wheat for potassa, it suggests also that the failure of this crop of late may be owing to the same deficiency of the salts of potassa in the soil which has caused the premature destruction of the peach; and, though the manure employed in the cultivation of wheat contains potassa, yet it does not yield as much of this alkali as the plant requires for its greatest productiveness; few of the vegetables that unite in the constitution of manure containing so large a proportion as wheat. To meet this demand of wheat, I propose to employ unleached ashes in the cultivation of this cereal. Leached ashes, though containing but a small proportion of potassa, and that chiefly in the form

of insoluble silicate, have nevertheless been found one of the best fertilizers for wheat; and the unleached, if properly applied, would probably produce a much greater effect. This is as yet conjectural; but I have instituted an experiment which I hope may determine the point.

In the early Autumn I caused an acre of ground to be prepared for a wheat crop. It was divided into three parts, one of which was to be treated with fresh ashes exclusively, another with ashes and swamp muck, and the third with muck alone. The part treated with fresh ashes exclusively was first ploughed, and then sown with wheat and ashes, and finally harrowed; the ashes being applied to the surface, so that its potassa when dissolved by the rain should be in immediate contact with the germinating seed; instead of being ploughed in, as ordinary leached ashes are. The second part, after being covered with the muck, was ploughed; and the wheat and ashes were applied as before. The third part was simply treated with muck, then ploughed and sown with wheat.

The result of this experiment cannot be determined until the time of the wheat harvest next Summer; but, thus far, it is decidedly in favor of the ashes; the two-thirds which were treated with this material being obviously better grown than the part treated with muck alone. A glance of the eye is sufficient to show a decided line of demarcation, the ashed part being greener and further advanced than the remainder.

I have little doubt that the same remarks are equally applicable to the common potato. This is now a much less certain, and on the whole much less productive crop than formerly. I find that the potato stalks contain 55 parts of potassa in 1000 of ashes; so that the plant requires considerably more potassa than wheat. If, therefore, fresh ashes are to be a remedy for the failure of the wheat crop, they are likely to be even more so for the potato. The verification of this supposition experimentally I have reserved for the next year, when, if living, I propose to try an experiment on a large scale.

An objection to all the foregoing facts, in a practical bearing, is the question whence the ashes are to be obtained for carrying the proposition into effect on a large scale, and whether enough can be obtained for the purpose. An obvious answer to this objection is that, should ashes fail in any neighbourhood, recourse can be had to the crude potash of the shops derived from the lixiviation of the ashes of forests cleared in the course of cultivation, and, when these forests shall have all been destroyed, we may resort to the minerals containing potassa, as to the felspar in granite rocks, which contains a large proportion of that alkali.

But for a long time yet to come, and indefinitely as regards fruit trees, ashes can be obtained from the resources of the farm itself. If all the falling leaves of the woods and swamps, all the dead and dying branches or stems of trees, and all the weeds, trimmings of trees, and other rubbish of a farm be collected and burnt, enough ashes could probably be obtained annually, for an indefinite length of time, to keep all the fruit trees in full bearing.